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ITEM 5:* STATE OF THE ENVIRONMENT

HAZARDOUS ENVIRONMENTAL EVENTS

Report of the Executive Director

Note by the Secretariat

I. MAJOR ENVIRONMENTAL DISASTERS IN THE WORLD

A. *The eruption of Mount Pinatubo*

1. For 600 years Mount Pinatubo in the Philippines was dormant; on 2 April 1991 it exploded. The major phase of what has become one of the largest eruptions of the century began on 12 June 1991. It reflected the relative movement of plates of the earth's crust along the western Pacific rim, where an oceanic plate slides beneath the plate carrying the Philippines. This interaction generates molten rock that rises and eventually erupts explosively.

2. The most violent eruptions sent clouds as high as 30 km and unleashed avalanches of molten rock down the volcano's flanks. The eruption removed about 140m of the mountain's summit, and deposited 5 to 7 cubic kilometres of pumiceous pyroclastic-flow deposits, and about 0.2 cubic kilometres of tephra on its flank.(1) Tephra deposits virtually filled most headward valleys, with accumulations of coarser lapilli and ash up to 220m deep.(1) Ash was deposited up to 40 km from the volcano. Experts estimate that the amount of volcanic material spewed out was five to eight times that emitted by Mt St Helens in 1980.(2) Although the explosion of Mt St Helens blew out the side of the mountain and spread ash over the surrounding countryside, it sent very little material into the stratosphere.(3)

3. In addition to the eruptions, typhoon-generated rain combined with falling ash on the flanks of the volcano gave rise to "lahars" or mudflows of volcanic debris which swept everything in the way.

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* Refers to the number of the item on the Provisional Agenda (UNEP/GC.17/1).

4. The President of the Philippines declared a state of emergency in the affected municipalities and created a task force to identify and set priorities for rehabilitation activities. The volcano-related deaths from all sources reached 932, but would have been much higher if 64,000 inhabitants from a nearby area had not been evacuated prior to the major eruptions - after an eruption had been successfully predicted by a team of volcanologists. Poor sanitation, malnutrition and epidemics of diseases took a severe toll in the evacuation camps.(2),(3),(4)

5. As yet, only a fraction of the volcanic debris which piled up on the mountain's flanks has washed down in rains. Lahars occur when rain loosens the ash and rocks and sends a torrent, up to 4 metres high, down the slopes. Most of the lahars occurring from June to mid-September 1991 were pumice-rich debris flows, triggered mostly by monsoonal rainstorms. Typhoon-related rainfall in late July produced bigger flows. It is estimated that as much as 1.2 to 3.6 billion cubic metres of sediment could wash down onto low-lying areas around the mountain within the next 10 years during rainy seasons, endangering residents of villages in the shadow of the mountain.(1) Based on observed sediment delivery rates at Mt Galunggung (Indonesia) and Mt St Helens, the sediment delivery rate at Mt Pinatubo should have been highest in 1991 and 1992, and then should decrease in an approximately exponential fashion. However, a typhoon could cause an abrupt increase in sediment delivery rates in any given year.(1) Government engineers have been trying to solve the problem by building defensive dams and catchment basins to channel mudflows away from populated areas, but evacuation is the best method of protecting people. Radio-telemetered lahar sensors and observers at upstream observation posts provide a lahar warning system for those still living in lowland areas.

6. As a consequence of storms since the eruption, a million people have been affected by floods and mudflows. Several people have been killed, villages buried, tens of thousands of houses flooded, roads destroyed and bridges swept away. Winds from the storms have blown ash to the capital, Manila, 100 km to the south, coating buildings and cars with a fine layer of grey-white dust and disrupting aircraft flights.

7. The Government has estimated that eruptions and lahars caused more than $260 million worth of damage to public and private property. A total of 250,000 people lost their homes and farmland was buried. The eruption shut down the former United States Clark Air Base, destroying many buildings and burying it under ash. Due to the continuing problems after the Mt Pinatubo eruptions, estimates for reconstruction costs, future income and infrastructure losses are likely to rise much higher.(2)

Possible effects on climate

8. There is much speculation about the effect the eruption could have on global climate. Cold weather followed the eruptions of Krakatoa in 1883 and Tambora in 1815.(5)

9. During an eruption, the force of the explosion may fire material many thousands of feet into the air, but the larger particles, such as stone, quickly fall out of the plume. The superheated sulphur dioxide and other gases rise into the stratosphere 20 to 30 km above the earth's surface, where very strong winds sweep the plume around the equator and other winds gradually spread it until the entire planet is covered in a thin volcanic veil.

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10. The major factor at work in the climatic effect is not the familiar dust cloud, but a chemical reaction - the vast quantities of superhot gases such as sulphur dioxide (Pinatubo emitted about 18 million metric tonnes of SO_2 into the stratosphere) (2) that reached the stratosphere and surrounded the globe later combine with other compounds to form tiny supercooled droplets of sulphuric acid.(6) The droplets constitute a long-lasting global haze that reflects and scatters back into space some of the sunlight which would normally have reached the ground; this results in a cooling of the earth. The droplets gradually fall to earth, but can be expected to last as long as 8 to 10 years, although they would not have an important impact on the climate for that long. It is provisionally estimated that this sulphur-rich eruption, which is of the type currently thought to have the maximum climatic effects, will temporarily reduce global mean surface temperature by 0.3 degrees - 0.5 degrees C over the next year or so. Radiative forcing calculations indicate that these aerosols can also be expected to exert a significant negative (resulting in cooling) but transient radiative forcing on the surface troposphere system over the next few years. This is opposite in sign to the greenhouse gas-induced forcing, which results in warming. General circulation model (GCM) simulations suggest that such an aerosol-induced forcing could result in a temporary cooling tendency at the surface and dominate the global surface temperature record in the next year or more. If this cooling happens, the consequences of the Pinatubo eruption could dominate the global surface temperature record in 1992 or a little beyond.(7)

11. An average global cooling of half a degree would scarcely be noticed, but it is important in the context of the global warming problem, as it could prevent the identification of the global warming trend that most atmospheric scientists believe is occurring.(5) If this is so, the warming could suddenly surge through the mid-1990s as the plume disappears.

12. There is a fairly constant relationship between the amount of sulphur dioxide in the stratosphere and a decrease in surface temperatures. The eruption of El Chinchon in Mexico in 1982, previously the biggest eruption of the century in terms of material shot to stratospheric heights, emitted sulphur dioxide which some scientists believe had an appreciable effect on the climate. Observations over the past decade indicate that the stratospheric aerosol concentration throughout most of the 1980s remained higher than that measured in 1979. This is probably largely attributable to the major El Chinchon volcanic eruption, together with the effects of a few other minor eruptions. Temperatures were probably forced down by a few tenths of a degree for a couple of years, but this may have been masked by increased ocean temperatures, related to an El Niño event in the eastern Pacific.

13. It is possible that the 1992 El Niño event may also have obscured the atmospheric cooling effects of the Pinatubo cloud.

14. The sulphur-rich emissions of El Chinchon were thought to be unique, but research on Mt Pinatubo indicates that climate-modifying volcanic eruptions are more common than previously believed.

Possibility of ozone depletion

15. There is speculation that ozone depletion will worsen because of the sulphur, which provides a platform for the reactions associated with ozone, involving chlorine from chlorofluorocarbons (CFCs). Some scientists predict that other volcanic particles might enable chemical reactions that would destroy ozone.(6) Atmospheric chemists will be carefully monitoring the stratosphere to find out just how much effect the eruption is having on the ozone layer itself.(3)

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Distortion of satellite images

16. The haze of Pinatubo is changing satellite images of the ground and, because of the back-scattering effect of the haze, the signals detected by remote-sensing satellites tend to be affected. Satellites which gather information in the infra-red part of the spectrum for measuring water vapour and sea surface temperature will need to be recalibrated.(3)

Further eruption

17. During July 1992, there were indications that the mountain might be gearing up for another violent eruption. The volcano emitted ash and steam, a build-up of pressure was indicated as molten rock pushed to the surface and a dome rose slowly out of the water-filled crater. Hundreds of small tremors shook the mountain. Volcanologists were forced to declare a 10 km circle around the volcano a danger zone. By December 1992, the frequency of earth tremors had sharply declined and the movement of magma to the volcano's surface had virtually stopped. The risk of another eruption seems to have passed.

B. *The Environmental Situation in Central and Eastern Europe and the Commonwealth of Independent States*

18. The overall environmental situation in the above countries is serious although a definite and valid assessment has not yet been made. The prime problems are the safety risks of nuclear power generation; air and water pollution; and extensive hazardous waste and toxic chemical problems, with correspondingly great health and ecological impacts and high costs.

19. The institutional base in the area is still being organized; however, it is clear that environmental policies and priorities, methods of planning, the funding of investment, monitoring and enforcement all require major revision. This is not easy under present economic conditions.

20. There is a threat of serious environmental disasters; for example, flash floods in the northern part of Montenegro have damaged the Mojkovac Dam, which retains in a basin about 3.5 million cubic metres of highly toxic waste (mainly toxic mud and sand). The waste, primarily from a lead and zinc mine was stored from 1976 to 1990 and the dam prevents it from reaching the Tara River, which runs past its base. However, the Tara River has been eroding this base, leaving its wall perilously thin. The Tara River flows into the Sava River, a tributary of the Danube, which runs on into the Black Sea. If the Mojkovac Dam were to collapse, the toxic waste would slide down into the river system.

21. The United Nations had imposed economic sanctions on Montenegro, but the sanctions committee gave approval for a joint UNEP/United Nations Centre for Urgent Environmental Assistance/Department of Humanitarian Affairs - Office of the United Nations Disaster Relief Coordinator emergency mission to be sent to Montenegro to plan to repair the dam. The first step of the resulting recommended plan of action was to protect the dam from further erosion by constructing smaller dams upstream to absorb the energy of the river and allow the strengthening of the base of the dam. With the arrival of dam material and other emergency European Community aid, the immediate threat seems to have been averted. The eventual aim is to cover and replant the surface of the dam, which currently causes problems when chemicals from its dried out crust are dispersed in a grey dust which could be having serious effects on people, animals and plants.

22. The case of the Mojkovac Dam should not be regarded as an isolated event. Another example, covered in more detail in the Governing Council report on Emerging Environmental Issues, is the dumping of radioactive materials in the Barents and Kara Seas in the Arctic region. Many similar hazardous situations and accidents in the countries of Central and Eastern Europe and the Commonwealth of Independent States may be pending or may have occurred already, without the knowledge of the international community.

C. *Cyclone in Bangladesh*

23. On 29 April 1991, a cyclone with winds reaching 225 kmh swept across the south-eastern coast of Bangladesh. The winds created waves up to 7m high which razed more than 780,000 homes. By 21 May, 138,866 people had been killed and 138,849 injured.(2)

24. A survey by the Food and Agriculture Organization (FAO) and the World Food Programme (WFP) in June 1991 reported that about 13.4 million people lived in areas affected by the cyclone and, of these, more than 3 million lived in the most severely affected districts - Chittagong, Cox's Bazar, Noakhali and Bhola. Nearly 80,000 people died in Chittagong, where the main port was wrecked and some 20 navy and cargo vessels sank. On Sandwip Island, in Chittagong district, some 35,000 people perished, 60 to 70 per cent of houses were washed away and 70 per cent of crops were lost. Heavy loss of life was also reported in Cox's Bazar district: on the island of Kutubdia - which had a pre-cyclone population of 110,000 - about 20,000 people died and another 2,000 were missing; 80 to 90 per cent of all structures were destroyed and all livestock was lost. Entire populations were wiped out on some of the region's smaller islands. In total, about 780,000 homes were destroyed, and 9,300 schools and 655 health centres were damaged or destroyed.(2)

25. The agricultural sector also sustained serious damage. The FAO/WFP survey reported that 247,000 tonnes of cereal crops and 35,000 tonnes of vegetables and other crops were lost. According to government estimates, 224,000 head of cattle, 218,000 goats and 2.4 million head of poultry perished in the storm. Surviving livestock were in poor health and lacked sufficient feed.(2) In Chittagong district alone, farmers lost about 58,000 hectares of land to sea water, and the salt level in the remaining soils increased 10-fold.(8) The forestry sector suffered considerable losses of fuelwood and timber: an estimated 424,702 m^3 of softwood and 93,445 m^3 of hardwood.(2)

26. Losses in the fisheries sector included damage to 31,000 hectares of shrimp farms and to fish-processing plants, vessels and stocks. Besides rotting corpses, tidal waves washed thousands of tonnes of untreated industrial, chemical and domestic waste into the sea. Coastal mangrove plantations were also damaged, reducing the extent to which the region's coasts are protected from erosion.

27. The overall economic losses are not known, but have been estimated at billions of United States dollars.(8) The Bangladesh Government's priorities in the immediate aftermath of the cyclone were to provide victims with access to clean water and food, and to restore communications and other vital services. The Government immediately allocated $400 million for relief and rehabilitation.(2) Experts say 25 percent of Bangladesh's 143,998 square kilometres should be forested, compared with six percent at present, to ensure ecological balance and to reduce damage from cyclones.

D. *Shetland Islands oil spill*

28. At the time of compiling the present report, the tanker "*Braer*" had broken up in storms a week after running aground on the southern tip of Scotland's Shetland Islands on 5 January 1993. The Liberian-registered ship grounded after losing power during a routine voyage from Norway to Canada. The accident is thought to have spilt the entire cargo of 84,000 tonnes of crude oil into the sea.

29. This spill is more than twice the discharge from the "Exxon Valdez" disaster in 1989 - 24.6 million gallons compared to 11 million gallons. The effects on the local marine environment and rugged shoreline, rich with marine life and sea birds, could be devastating. However, it is hoped that stormy weather may have driven much of the oil out to sea, and that the environmental effects of the accident will be less harmful than those of the "Exxon Valdez" accident due to the fact that the Shetlands environment is warmer than in Alaska. Chapter III of the present report examines the long-term impacts of the Alaskan oil spill.

II. HAZARDOUS ENVIRONMENTAL EVENTS WITH SPECIAL REFERENCE TO AFRICA

Introduction

30. The most serious environmental events to strike Africa in the last two years include natural disasters (drought, earthquakes and epidemics) and anthropogenic disasters. such as the dumping of toxic and hazardous wastes.

A. *Drought emergency*

31. Severe droughts occurred during 1982-1984, affecting the Sudano-Sahelian area of Western Africa, eastern and southern Africa; as well as South-East Asia, the Western Pacific and Australia; and northern and north-eastern regions of Latin America. The worst-affected areas, both in terms of drought intensity and duration, were in Africa (9) where, for example, during 1982-1984 some one million Ethiopians starved to death from the combined effects of drought and civil war. A somewhat less severe drought occurred during 1986-1987 over parts of the African continent.(10) Then, in 1991-1992 the worst drought in recorded history affected southern Africa, as well as parts of eastern Africa and the Sahel - most affected countries experienced delayed rainy seasons and significant rainfall deficiencies. Some rainfall stations, e.g. in Central Sudan and in some southern African countries, reported the lowest rainfall ever recorded. The rainy season re-established itself in the latter part of 1992. Even so, soil erosion, sometimes severe, was a secondary effect of the rain returning to the parched ground, denuded of vegetation.

32. The drought affects millions. In 1992, a region of nearly 700 million hectares in southern Africa was struck by the drought, affecting 130 million people in Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, the United Republic of Tanzania, Zambia and Zimbabwe. The size and scale of the drought threatened the social fabric and fragile economies of several of those countries.(10)

33. Refugees, desperate for food and water, and in some cases escaping factional fighting, fled to neighbouring countries, often arriving in a deplorable state, suffering from malnutrition and disease. The receiving countries are struggling to care for them, but various problems, including civil strife, have kept supplies from reaching the starving.

34. Drought has accelerated the migration of farmers from the countryside to the cities, putting additional pressure on basic city services such as water and sanitation. Water-dependent industries shut down, throwing thousands out of work. At the height of the drought, Bulawayo almost ran out of water completely.

35. There has been conflict between conservationists and farmers, desperate to use game reserves for grazing land. Added pressure has been put on reserves by people poaching animals and collecting fuelwood. Wild animals have been dying of starvation and thirst, so that culling and translocation have been required.

36. The severity of the drought has taken a heavy toll on food supplies. Millions of livestock and large areas of crops have perished. Some 6 million people in Malawi, 4.6 million in Zimbabwe and 3.15 million in Mozambique are at risk from severe malnutrition. Thousands are dying in war-torn Ethiopia, Somalia and the Sudan. It is estimated that, altogether, 20 countries in Africa are facing exceptional food emergencies. Imports of food and lost production of export commodities due to the drought are costing impoverished treasuries scarce foreign exchange.

37. International food aid has been crucial. For example, a two-day pledging conference on the threats posed by the drought, with special reference to southern Africa, took place in Geneva from 1 to 2 June 1992. It was jointly hosted by the United Nations and the Southern African Development Coordination Conference (SADCC). A sum of nearly $600 million was pledged, mainly by Western countries, for food and other aid for impoverished nations.(10)

38. In January 1993, FAO forecast that Africa would need massive food aid in 1993 to prevent thousands of people from dying. Although food distribution has improved in Somalia, drought and civil strife mean millions in Ethiopia, Liberia, Sierra Leone, Sudan and elsewhere in Africa will need food assistance through 1993. According to FAO - Angola, Botswana, Ethiopia, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mauritania, Mozambique, Namibia, Rwanda, Sierra Leone, Somalia, Sudan, Swaziland, the United Republic of Tanzania, Zaire, Zambia and Zimbabwe faced exceptional food emergencies.

39. Although the Drought Monitoring Centre in Nairobi had predicted the drought, the world took action only after observing its impact in 1992. In the interim, thousands of lives were lost. If the predictions had been heeded, more timely action could have allowed the affected countries to prepare better for the impact of the drought.

40. Today it is generally acknowledged that the El-Niño Southern Oscillation (ENSO) events are responsible for major disturbances of the global atmospheric circulation. ENSO is a recurrent combination of ocean temperature and air pressure anomalies which occurs mainly in the Pacific but whose effects are felt world-wide. For example, ENSO results in bands of high pressure over the African region which cause rain-bearing clouds to disappear. Such "warm" episodes occur about twice a decade (although not all are severe enough to disturb significantly the global weather patterns) and usually last from 12 to

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18 months. In Africa it has been observed that, during an ENSO episode, the Intertropical Convergence Zone is generally diffuse due to weak monsoons and enhanced subsidence. The evolution of the 1991-1992 ENSO had similar characteristics to that of 1982-1983. The drought of 1991-1992 is in many ways very similar to that of 1983-1984, although the impact of the current drought may be more severe than that felt in 1983-1984, due to a more degraded ecosystem today.

41. ENSO is also blamed for recent drought ravaging crops and costing hundreds of millions of dollars in the Asian and Southern Pacific region, including in Australia, China, India, Malaysia, Philippines, Sri Lanka, and Taiwan.

B. *Earthquake in Egypt*

42. Many hundreds of people died and thousands were injured in an earthquake measuring between 5.5 and 6.0 on the Richter scale that struck Cairo on 12 October 1992. Earthquakes are rare in Egypt and this was the most powerful ever recorded. Cairo's 15 million inhabitants make it one of the most densely populated cities in the world, (11) and residents were caught off guard when the earthquake struck. Most deaths occurred in the poor districts where many families live in badly built tenement blocks and many building collapses were reported.

C. *Dumping of Hazardous Wastes*

43. Large amounts of hazardous wastes have been exported or proposed to be exported to developing countries, particularly in Africa, from industrialized countries.

44. The Organization of African Unity (OAU) held a conference in Bamako, Mali, in January 1991 and drew up an African Convention on the Ban of All Forms of Hazardous Wastes Into Africa and the Control of Transboundary Movements of Such Wastes Generated within Africa (the Bamako Convention). It was signed at the conference, and placed a ban on the import of hazardous wastes into Africa from non-contracting Parties, and bans the transit of hazardous wastes through the territory of the respective States in order to protect human health and the environment. Such import of hazardous wastes shall be deemed illegal and a criminal act. Despite this, the trade continues, as is seen from the examples in paragraphs 46 and 47 below.

45. In October 1992, a deal between two European firms and a national of Somalia for the annual shipment of about half-a-million tonnes of hazardous wastes to Somalia was aborted by UNEP. UNEP was able to follow up the issue very quickly with the concerned Government.

46. In March 1992, Egyptian authorities at the port of Alexandria refused to allow the unloading of a cargo of 950 tonnes of plastic wastes derived from scrap cars. The waste originated from a smelter near Koblenz, Germany, the "Blei und Silberhuette Branback BSB". The shipment had been registered as a "substitute fuel" which, under German law, is treated as a commodity and requires no special export license. It was to be delivered to Egyptian cement kilns as fuel for their ovens. The waste was loaded at Rotterdam, Netherlands, where Dutch port officials discovered that it was contaminated with 1.7 per cent lead, other heavy metals and polycyclic aromatic hydrocarbons. If burned in cement kilns, the toxic fumes would endanger the health of the local population. Under European Community regulations, the wastes would have been classified as

hazardous, and would have been subject to special and expensive disposal requirements. A similar shipment of 1,600 tonnes of the same wastes was unloaded at Alexandria in February 1992 for recycling by local cement firms. The German exporter, "Taurus Umwelttechnik", had further plans to export 20,000 tonnes of hazardous wastes to Egypt throughout 1992.

D. *Danger of further gas release at Lake Nyos, Cameroon*

47. In 1986, a cloud of gas released in an explosion from Lake Nyos, Cameroon, asphyxiated 1,734 people and many livestock in the worst natural disaster of the country's history. The carbon dioxide apparently came from a chamber of molten rock under the lake. This is the first known event of its kind.(8) In 1992, following concern that another build-up of gases is occurring, researchers began studying the feasibility of installing pipes in the lake to allow gases to be released harmlessly before they build up to dangerous levels.

E. *Epidemics*

48. Epidemics are not uncommon in Africa, and the number of cases of some diseases continues to rise. The year 1991 was characterized by unusually high levels of transmission of cholera, with many deaths. In Chad, for example, most of the country was plagued by the epidemic which reportedly affected 12,204 people and caused 1,262 deaths. At least 21 countries were affected, with a total of 153,367 reported cases and 13,998 deaths.(13) These are the highest totals ever recorded in Africa and, taking into account the incompleteness of data, indicate a major epidemic in the continent.

III. UPDATE ON PAST HAZARDOUS ENVIRONMENTAL EVENTS

A. *Long-term impacts of the Alaskan oil spill*

49. On 24 March 1989, the supertanker "*Exxon Valdez*" ran aground on Bligh Reef, Prince William Sound, Alaska, spilling more than 38 million litres of crude oil into this environmentally sensitive area. This was reported to the Governing Council in 1991.(14)

50. Immediately after the spill, the Exxon Valdez Oil Spill Trustees began a series of assessments to determine its effects on the environment, including marine and terrestrial mammals, birds, fish and shellfish, and on non-living resources such as archaeological sites. The assessments found evidence of a wide range of impacts, some immediate and acute, some subtle and persistent.(15) However, there seems to be no threat of species extinctions and food chains are apparently intact. The direct effects of the spill are expected to last up to 15 years and the long-term impacts are uncertain. The low temperatures of the area may influence the course of recovery by decreasing the rate of natural weathering of oil by physical processes or through biodegradation. These mechanisms are slower in colder climates and, as a result, petroleum hydrocarbons may be biologically present in the environment for longer periods of time.

51. Assessment of the spill is also under way by the Hazardous Materials Response and Assessment Division (HMRAD) of the United States Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). NOAA/HMRAD provides scientific support to the United States Coast Guard during spills of oil and hazardous materials. In 1990, NOAA/HMRAD assumed sponsorship of a long-term monitoring programme begun shortly after the spill. This programme aims to define and quantify effects from both oiling and intrusive shoreline

treatment (e.g. high-pressure, hot-water washing) on intertidal biological communities, and to track the course of biological recovery at affected sites. In addition, concerns about contamination of subsistence seafoods harvested in the affected region by native communities have resulted in the initiation of a programme (co-sponsored by NOAA/HMRAD) to collect and analyse seafood species for petroleum hydrocarbon content.

52. Humpback whales *(Megaptera)*, Steller's sea-lions *(Eumetopia jubata)*, sea otters, harbour seals and killer whales were included in the Exxon Valdez Oil Spill Trustees' damage assessment studies.(15) The results indicated that the spill had affected the population of humpback whales: in 1989 none were seen in Lower Knight Island Passage, a preferred habitat - although this may be attributable to other causes, such as the increase in vessel traffic throughout the area during the spill response.

53. Data from the sea-lion study were inconclusive. Several sea-lions were observed with oiled pelts, and petroleum hydrocarbons were found in some animals' tissues. Assessing the effect of the spill on the sea-lion population was complicated by seasonal movements of sea-lions in and out of the spill area, an ongoing population decline and a pre-existing problem with premature pupping.(15)

54. Mortalities were observed in some pods (groups) of killer whales - although the cause of these is uncertain. Several photo-identification censuses revealed that a significant number of killer whales were missing from at least one, and possibly two, pods in Prince William Sound. Assuming that whales missing for two consecutive years are dead, the mortality rates were 19.4 per cent in 1988-1989 and 20.7 per cent in 1990-1991.(15) However, it is not known what the overall mortality rate was for the entire population in the Sound. Changes were also observed in killer whale distribution and social structure.

55. Spilled oil covered large areas inhabited by sea otters and it was estimated 3,500 to 5,500 otters died from acute exposure to oil. Continuing long-term exposure to petroleum hydrocarbons may have a chronic effect on sea otters. High concentrations of petroleum hydrocarbons were detected in coastal sediment samples within the spill zone in western Prince William Sound and in staples of the sea otter diet, such as intertidal mussels and benthic marine invertebrates. Analyses of blood from sea otters in 1990 and 1991 indicated slight but significant differences in the blood of exposed animals. Abnormal patterns of mortality are continuing in sea otter populations.(15)

56. Two hundred harbour seals are estimated to have been killed by the spill. During 1989, oiled harbour seals were abnormally lethargic and unwary. One year after the spill, petroleum hydrocarbon concentrations in bile were five to six times higher in seals from oiled areas than in seals from unoiled areas, indicating that seals were still encountering oil in the environment and were mobilizing fat reserves containing petroleum hydrocarbons. Surveys conducted in August 1991 showed that seal populations at unoiled sites had increased significantly, while those at oiled sites had risen only slightly. (15)

57. Birds were among the most conspicuous victims of the oil spill. An estimated 375,000 to 435,000 were killed by the spill, with murres (from the auk family - *Alcidae*) as the species most severely affected. Approximately 172,000 to 198,000 adult breeding murres are believed to have been killed. Reproductive failure in several large colonies in years since the "*Exxon Valdez*" incident has been attributed to changes in numbers and behaviour due to the spill.

58. In 1989 and 1990 about 40 per cent of the harlequin ducks *(Histrionicus)* sampled had tissues contaminated with petroleum hydrocarbons, and about 33 per cent in the spill area had reduced body weight and were generally in a poor condition. The 1991 survey indicated a decline in the harlequin population and an almost total reproductive failure in oiled areas of Prince William Sound.(15)

59. The coastal tidal zone – normally highly productive and biologically rich – was the most severely contaminated habitat in 1989. It was also adversely impacted by shoreline treatments such as high-pressure, hot water washing. During the winter of 1990-1991, significant concentrations of petroleum hydrocarbons built up in sediment traps, indicating that oil is being removed from the beaches by cleaning and natural processes and is being transported subtidally. Intertidal organisms are still being exposed to petroleum hydrocarbons from subsurface oil on beaches, however the level of exposure as reflected in the total polynuclear aromatic hydrocarbon loading in tissues has declined steadily since the spill.

60. No massive kills of adult open-water fish were observed following the spill. However, there was some indication of adverse effects on eggs and larvae of some species of fish, especially those that inhabit and spawn in the intertidal zone. The longer-term impacts on fish populations are not clear.

61. The spill had a direct impact on archaeological resources, subsistence and recreational activities, and the aesthetic qualities of the region. Clean-up activities and the associated increase in human activity throughout the spill zone resulted in additional damage and erosion to the area. Spill response data revealed that a minimum of 35 archaeological sites had been damaged, including burial and home sites. In addition to oil contamination, increased knowledge of the location of archaeological sites puts them at greater risk from looting.

62. Following the oil spill, recreational use of public lands and waters declined. Sport fishermen, hunters, campers and sea kayakers avoided oiled areas and many adjacent areas that were affected by clean-up activity. In 1991, oil still remained in many areas used for recreation.(15)

B. *The Iraq/Kuwait conflict in 1991*

63. A separate report about developments with respect to the environmental situation in Kuwait is presented to the Governing Council for consideration at its seventeenth session.

C. *The Chernobyl nuclear power plant accident in 1986*

64. An update on the Chernobyl accident is presented as a separate report to the Governing Council for information at its seventeenth session.

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